D&T Knowledge organiser

- Smart materials
- Modern materials
- Composite materials
- Modern textiles

Smart materials react to their environment

They change their properties when their surroundings change

modern materials are newly developed materials

New materials have new and different properties to meet new demands

Composite materials are combinations that work well together

Composite materials benefit from sharing properties to make a higher performing material

Activities-

- Read and highlight key points
- Make a Mind Map or diagram for each sub heading with names, properties, examples and possible uses / products
  - Smart materials
  - Modern materials
  - Composite materials
  - Modern textiles

Use www.Technology student . com

https://www.ted.com/talks/catarina_mota_play_with_smart_materials

Thermo chromic pigments change colour with heat

Explain the benefits of these examples

Photo chromic pigments change colour reversibly in response to light

Write some examples of products

Glow in the dark

Phosphorescent pigments store light that hits them and slowly release it, so they glow in the dark

High Visibility Flourescent

Fluorescent pigments are really bright because they absorb light energy and then release them slowly which means they apper brighter than normal pigments

•Reflective finishes include reflective yarns, inks and coatings

Find good examples to use in the exam

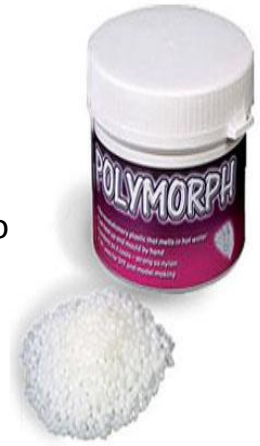
•Benefits & properties above orinary materials

•Where they would be used and why this helps the user

Smart materials have one or more properties/features that can respond to external stimuli, such as stress, light, temperature, moisture, pH, electric or magnetic fields and return to there original state when the stimuli is removed.

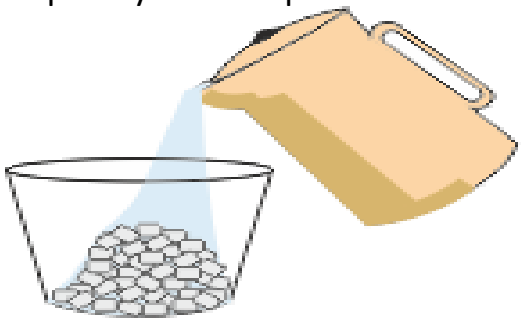
Examples include:-

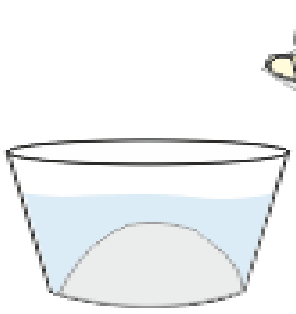
Polymorph



Polymorph is a thermoplastic material that can be shaped and reshaped any number of times. it is normally supplied as granules that look like small plastic beads. In the classroom it can be heated in hot water and when it reaches 62 degrees centigrade the granules form a mass of 'clear' material. When removed from the hot water it can be shaped into almost any form and on cooling it becomes as solid as a material such as nylon.

Although expensive, polymorph is suitable for 3D modelling as it can be shaped by hand or pressed into a shape through the use of a mould.





Shape memory alloys = Nitinol an alloy of Nichol and Titanium

SMART MATERIALS
SHAPE MEMORY ALLOY (SMA)

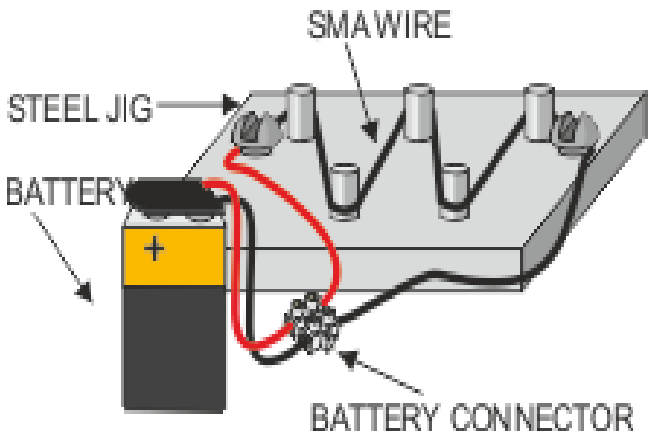
SMA wire also called 'Nitinol', as it is a composed of nickel and titanium. Looks like ordinary wire and has many of the same properties.

SMA has a memory - for example, if it is folded to form a shape and then heated above 90 degrees (centigrade) it returns to its original shape.

TWISTED SMA WIRE HEATED TO 90 DEGREES

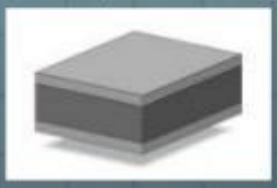
RETURNS TO ORIGINAL SHAPE

SMA can be 'programmed' to remember a shape. Clamp the SMA in position and pass an electric current through it. If the wire is now folded into another shape and then placed in hot water, it returns to the original 'programmed' shape.

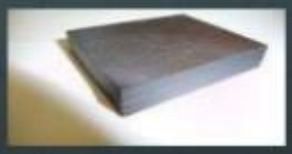


Types of Composites

Laminar composite



A composite material that consists of two or more layers of different materials that are bonded together

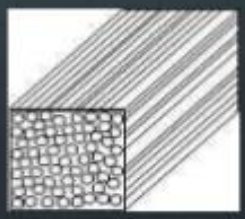


Fiber-reinforced composite

Composites with chopped or continuous fibers.

Particulate composite

Composites with embedded particles



Steel Reinforced Concrete

Concrete and steel, 2 materials that make it the concrete buildings much stronger and crack resistant

Kevlar

Kevlar As a woven material

Is used in bullet proof vests

Can be woven together. Kevlar is often woven with carbon fiber and resin to make light weight stronger than steel panels

.Resistant to stretching or breaking.

.Resistant to abrasion and cuttin

.High strength to weight

Composite Materials—are a **combination of 2 materials that make the material stronger**

Simply put, composites are a **combination of 2 components/materials** In industry, composites are materials made by combining two or more natural or artificial elements (with different physical or chemical properties) that are stronger as a team than as individual players.

The component materials don't completely blend or lose their individual identities; they combine and contribute their most useful traits to improve the outcome or final product. Composites are typically designed with a particular use in mind, such as added strength, efficiency or durability.

composites are a **combination of 2 materials that make the material stronger**

Glass Reinforced Fibre (GRP) fibre glass

◊Glass fibre, looks a little like fabric/denim. It is hard wearing but floppy and not very strong or hard.

◊It is covered in a glass like resin that goes really hard. It is also very brittle so breaks easy.

◊The resin is mixed with the fibre to make a very tough, hard, strong material. It can be made into unusual shape like boats helmets and car body parts.

Carbon Reinforced Fibre - known as carbon fibre

◊Strands of carbon fibre are very strong (high tensile strength).

◊Carbon is very light for its strength

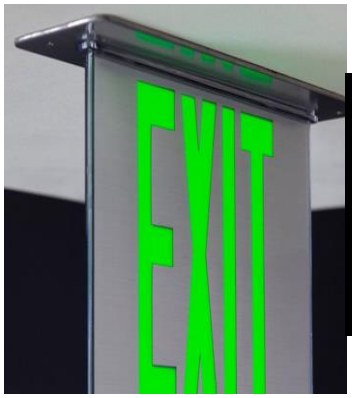
◊When mixed with Resin (a plastic glue) the fibres are held firmly in place to make strong shapes.

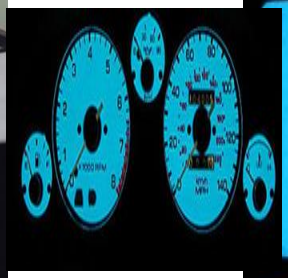
◊Used for racing car parts and performance sports equipment

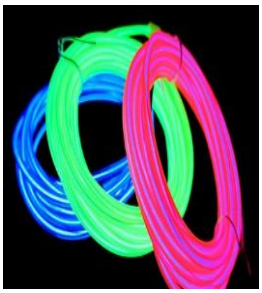
Electroluminescent film or wire i.e. LCD

Electroluminescent materials give out **light** when an electric current is applied to them.









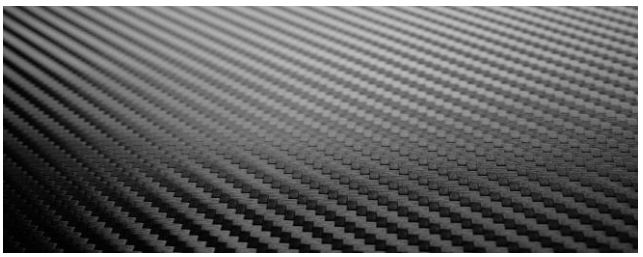

Electroluminescent (EL) wire or film is a thin, flexible wire or film that glows brightly when an alternating current is passed through it. It is available in different colours and can be cut to length. The glow is produced by a phosphor coating and the colour is determined by the plastic sleeve covering the wire or film. The wire/film is connected to a small battery powered circuit called an 'inverter'.

Quantum-tunnelling composite (QTC) is a **flexible polymer which contains tiny metal particles**. It is normally an insulator but if it is squeezed it becomes a conductor.
QTC can be used to make membrane switches like those used on mobile phones, pressure sensors and speed controllers.

The following are possible uses of QTCs:
•Sporting materials such as training dummies or fencing jackets can be covered in QTC material. Sensors on the material can relay information on the force of an impact.
•Mirror and window operation such as gesture, stroke, or swipe can be used in automotive applications. Depending on the amount of pressure applied from the gesture, the car parts will adjust to the desired setting at either a fast speed or a slow speed. The more pressure is applied, the faster the operation will take.
•Blood pressure cuffs: QTCs in blood pressure cuffs reduce inaccurate readings from improper cuff attachment. The sensors tell how much tension is needed to read a person's blood pressure.

Based on the information above, how can you summarise what QTC does

Carbon Fibre composite

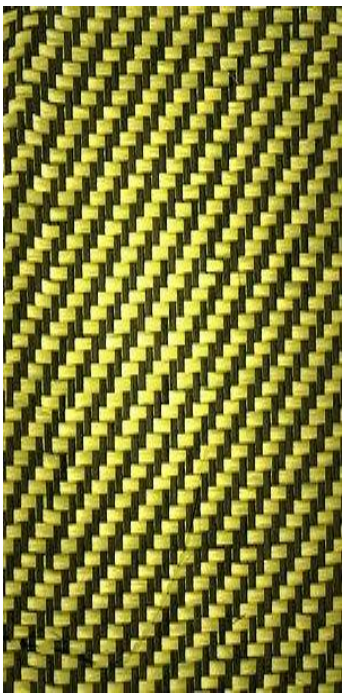


CF is sometimes referred to as Carbon Fibre Reinforced Plastic is similar to fibre glass. Carbon fibre is woven into a textile material and resin such as epoxy resin is applied and allowed to cure. **The resulting material that is very strong as it has the best strength to weight ration of all construction materials**. It is an improvement on glass fibre reinforced plastic, although much more expensive.

Carbon Fibre Reinforced Polymers tend to be used in the manufacture of expensive sports cars, where strong and light materials are required. Expensive, competition bicycles and motorbikes tend to have CFRP frames, forks, handlebars to keep weight to a minimum and yet retain great strength. The aerospace industry has embraced the use of CFRP in the manufacture of planes.

Eurofighter: Is Europes recently developed fighter aircraft. The airframe is 70% Carbon Fibre Composite (CFC), resulting in a plane that is 30% lighter than if it had been constructed from modern metals.

Kevlar® is a liquid that is converted into a fibre (called aramid fibres) and then woven into a textile material. The resulting textile material is extremely strong, lightweight, corrosion and heat resistant. It is often used in combination with other materials, forming composites. It has a wide range of uses. Kevlar® was developed at DuPont in the 1960s.



Kevlar® has a high tensile strength to weight ratio, far exceeding steel and even specialist metal alloys, such as magnesium alloys, used in aerospace engineering.

For this reason it is used extensively in the manufacture of panels and wings for fighter jets, including the Eurofighter Typhoon. During the manufacture of Formula One racing cars, Kevlar® is used for the bodywork and petrol tank. Kevlar has many other uses.

When woven, Kevlar® forms a strong and flexible material. If layers of the woven Kevlar® are combined with layers of resin, the resulting 'rigid' material is light and has twenty times the strength of steel.

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Biometrics

Biometrics means to measure and analyse some human characteristic in order to correctly identify an individual. Examples of physical characteristics which can be used are:

- •fingerprints
- •voice patterns
- •retinas or irises
- •facial patterns
- •palm prints

The use of biometrics is becoming more commonplace as the techniques are refined and become more reliable.
Many businesses now use biometrics as a method of allowing access to buildings and information held on computer systems. Governments such as the UK are including biometric identifiers in passports.

•What products have you used that uses Biometrics?
•What products at home can be developed to use biometrics in order for it to work? Brainstorm some ideas

Textiles Modern Materials

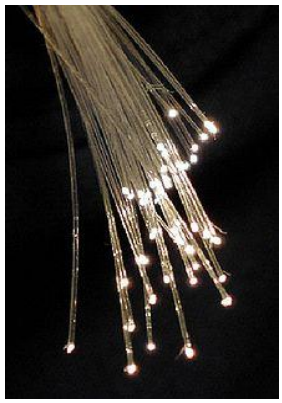
Modern materials are those that are continually being developed through the invention of new or improved processes

Examples include:-

- Teflon
- Fibre Optics
- Neoprene
- Paperfoam
- Cornstarch Polymers
- Lyocell
- Nano Technology
- Synthetic micro fibres
- Lycra blends
- Polartec
- Composite materials
- Cellular materials
- Carbon/Kevlar fibre
- Maplex

Mountain Boots made from Synthetic Micro Fibres

Neoprene Laptop Cover



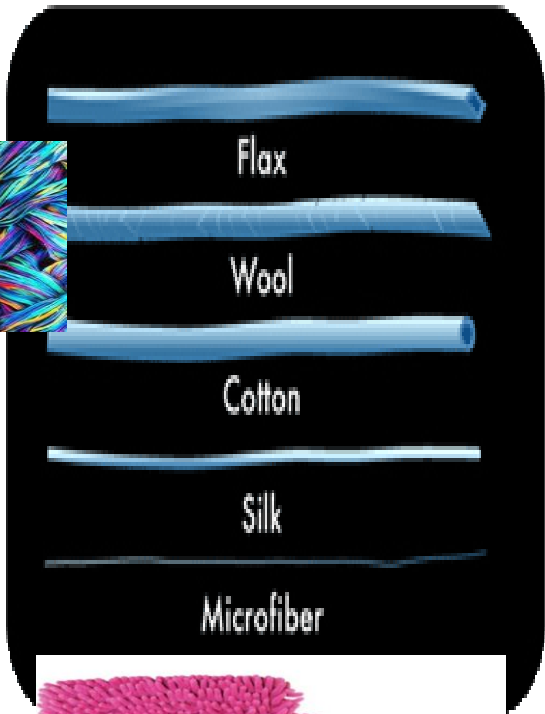
Fibre Optics

Teflon film on Photovoltaic Solar cells – for power

Helmet made from Carbon/Kevlar fibre

Microfibres

- Extremely fine synthetic fibres, mainly polyester and polyamide
- They are very lightweight,
- Soft and drape well
- Lifts and traps moisture allowing it to evaporate quickly keeping the user warm and dry. Used for a variety of clothing products
- Often blended with natural fibres to give high performance fabrics for outdoor and sports use.
- TACTEL-is a polyamide microfibre
- TENCEL-is a regenerated mircofibre classed as LYOCELLS
- Also good for cleaning as it traps dirt better than cotton.

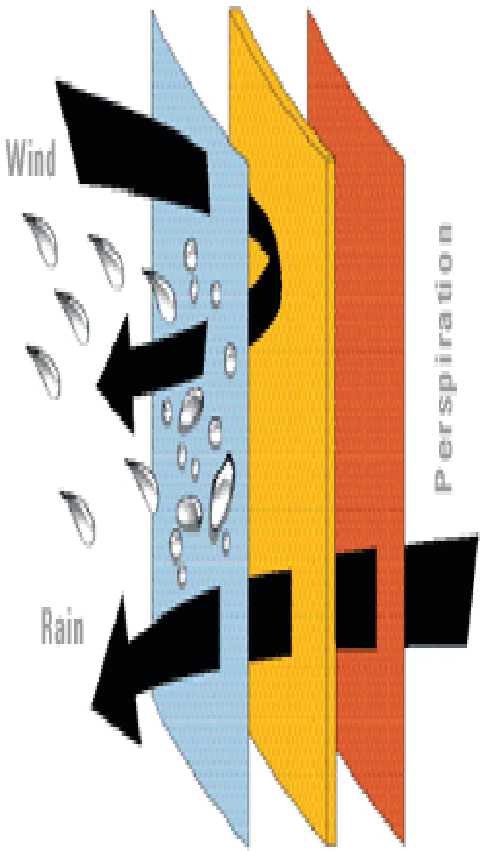


Kevlar – for protective clothing

- heat-resistant and strong
- They are used in aerospace and military applications, for ballistic rated body armour fabric and ballistic composites, in bicycle tires, and as an asbestos substitute
- good resistance to abrasion and cut resistant
- good resistance to organic solvents
- low flammability, no melting point, degradation starts from 500°C

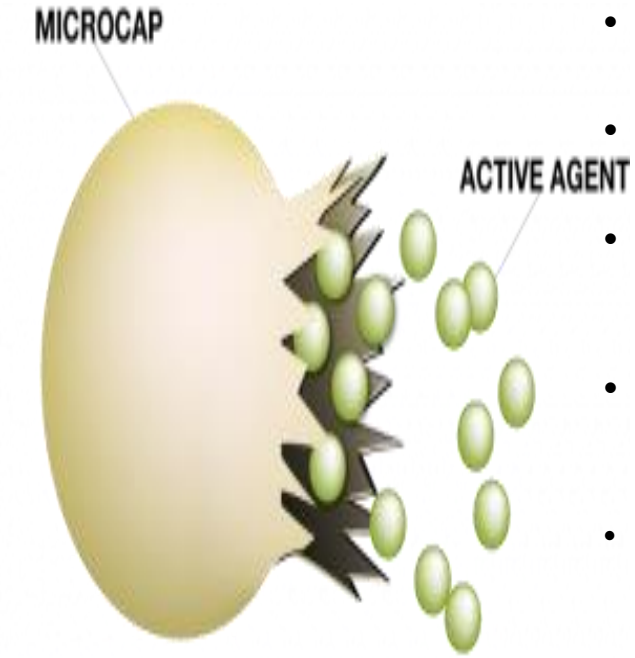
Kevlar protective sleeves provide protection from heat. These sleeves also help prevent getting cut when lifting hot or sharp objects.

Gortex – waterproof & breathable membrane

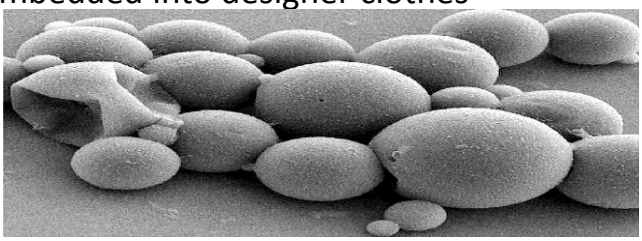


- Waterproof breathable fabric is engineered to handle two tasks simultaneously: repel precipitation and release perspiration vapor.
- Blocks wind
- Only used with synthetics- naturals absorb but the moisture can go back onto the skin
- Used in tents and waterproof walking gear.
- Wound care- creates a barrier that stop moisture going back onto the skin but allows the skin to breathe

Microencapsulation



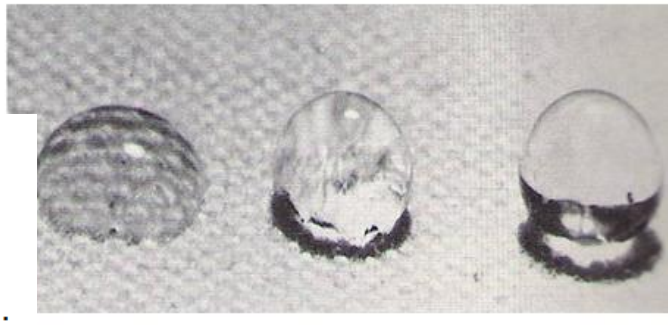
- A way to insert, fragrances, antibacterial substances into fibres
- Capsules are broken through friction and release the scent, or chemical
- You can insert moisturisers into tights to condition the skin, or caffeine to prevent tired legs
- Facemasks at hospitals may have it in to prevent germs spreading, in fabric conditioners,
- Embedded into designer clothes



Water-repellent finishes

- Nano-technology can be used to make fibres hydrophobic so they repel water and stains, eg NanoSphere®.
- Anti-static finishes are applied to *dry* fibres, eg polyester and polyamide.
- Lubricants and softeners can be applied to the fibres but do not always give a permanent finish.
- Fibres can include carbon or be coated with silver or copper to increase the electrical conductivity.

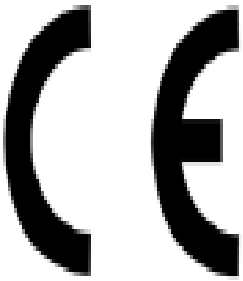
- Water-repellent finishes prevent water molecules from breaking down and being sucked (wicked) into the fabric.



Fire resistant Chemical finishing – Probane & Pyrovatex

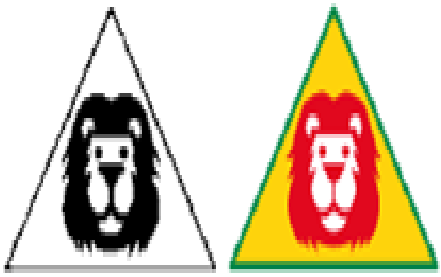
- Flame resistant finishes on cellulosic fibres include *Proban* and *Pyrovatex*.
- Both finishes increase the stiffness of the fabric, reduce tearing strength and are expensive. The use of soap detergents, bleaches and high temperature washing can remove the finish and leave the fabric more flammable.

Toy safety – safety and law



The CE Symbol

- Toys must have this on them by law. It indicates the toy meets the European Toy Safety Directive. This is aimed at Trading Standards and tells them the toy is allowed to be sold in Europe. It is less relevant to the average consumer and doesn't necessarily indicate quality and safety for the consumer.



The Lion Mark

- Developed by the British Toy and Hobby Association as a symbol of toy safety and quality. It can only be used by members of the BTHA. This is a voluntary symbol.

Age Appropriate Labels

- One of the principles of the Lion Mark scheme is that toys are used by children of an appropriate age. This symbol indicates the toy is not suitable for a child under 3 e.g. because of a choke or suffocation hazard.

The Kitemark

- Some toys also carry the British Standards Institute Kitemark. This indicates the toy has been independently tested and complies with BS EN 71.